

1 **WHAT IS CLAIMED IS:**

- 2 1. A method for heating a catalyst bed for start-up, comprising:
3 providing a catalyst bed having an upstream face and a downstream face;
4 providing an electrical heating element positioned along one face of the catalyst
5 bed;
6 passing a small flow of reactants through the electrical heating element and
7 catalyst bed; and
8 heating the electrical heating element to initiate an exothermic reaction at the face
9 of the catalyst bed, wherein the heat of reaction propagates throughout the
10 catalyst bed thereby heating the catalyst bed for start-up.
- 11 2. The method of claim 1, wherein the electrical heating element is positioned along
12 the upstream face of the catalyst bed.
- 13 3. The method of claim 1, wherein the electrical heating element is formed in a
14 spiral design along one face of the catalyst bed.
- 15 4. The method of claim 1, wherein the catalyst bed is selected from the group
16 consisting of pellets, extrudates, spheres, monoliths, and any combinations
17 thereof.
- 18 5. The method of claim 1, wherein the catalyst bed contains catalyst selected from
19 the group consisting of autothermal reforming catalysts, partial oxidation
20 catalysts, steam reforming catalysts, water gas shift catalysts, preferential
21 oxidation catalysts, anode tailgas oxidation catalysts, and sulfur absorbents.
- 22 6. A reactor module for use in a compact fuel processor, comprising:
23 a catalyst bed having an upstream face and a downstream face; and

1 an electrical heating element positioned along the upstream face of the catalyst
2 bed, the heating element capable of initiating an exothermic reaction at the
3 upstream face of the catalyst bed in the presence of a small flow of
4 reactants.

5 7. The reactor module of claim 6, wherein the electrical heating element is formed in
6 a spiral design.

7 8. The reactor module of claim 6, wherein the catalyst bed is selected from the group
8 consisting of pellets, extrudates, spheres, monoliths, and any combinations
9 thereof.

10 9. The reactor module of claim 6, wherein the catalyst bed contains catalyst selected
11 from the group consisting of autothermal reforming catalysts, partial oxidation
12 catalysts, steam reforming catalysts, water gas shift catalysts, preferential
13 oxidation catalysts, anode tailgas oxidation catalysts, and sulfur absorbents.

14 10. A reactor module for use in a compact fuel processor, comprising:
15 a catalyst bed;
16 a cooling coil positioned substantially within the catalyst bed for removing excess
17 heat during normal operation; and
18 an electrical heating element positioned within the cooling coil, the heating
19 element capable of heating the catalyst to a desired reaction temperature.

20 11. The reactor module of claim 10, wherein the catalyst bed is selected from the
21 group consisting of pellets, extrudates, spheres, monoliths, and any combinations
22 thereof.

- 1 12. The reactor module of claim 10, wherein the catalyst bed contains catalyst
2 selected from the group consisting of autothermal reforming catalysts, partial
3 oxidation catalysts, steam reforming catalysts, water gas shift catalysts,
4 preferential oxidation catalysts, anode tailgas oxidation catalysts, and sulfur
5 absorbents.
- 6 13. A method for heating a catalyst bed, comprising:
7 providing an electrical heating element positioned within a cooling coil located
8 substantially within the catalyst bed; and
9 heating the electrical heating element thereby heating the catalyst bed to a desired
10 temperature.
- 11 14. The method of claim 13, wherein the desired temperature is the start-up
12 temperature.
- 13 15. The method of claim 13, wherein the desired temperature is the desired reaction
14 temperature during transient operation.
- 15 16. A method for heating a catalyst bed to a desired temperature, comprising:
16 providing a catalyst bed in communication with an electrical heating element; and
17 heating the electrical heating element so as to maintain the desired temperature of
18 the catalyst bed.
- 19 17. The method of claim 16, wherein the desired temperature is the start-up
20 temperature.
- 21 18. The method of claim 16, wherein the desired temperature is the desired reaction
22 temperature during transient operation.

- 1 19. The method of claim 16, wherein the electrical heating element is weaved through
2 the catalyst bed.
- 3 20. The method of claim 16, wherein the catalyst bed is a monolith.
- 4 21. The method of claim 18, wherein the electrical heating element is wrapped around
5 the monolith.
- 6 22. A method for heating a catalyst bed to a desired temperature, comprising:
7 positioning an electrical heating element upstream of the catalyst bed; and
8 passing a fluid across the electrical heating element and through the catalyst bed,
9 wherein the catalyst bed is heated to the desired temperature.
- 10 23. The method of claim 22, wherein the desired temperature is the start-up
11 temperature.
- 12 24. The method of claim 22, wherein the desired temperature is the desired reaction
13 temperature during transient operation.
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